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IS 12244-1 (1988): Colorimeter thermometers, Part 1:
Solid-stem thermometers [CHD 10: Glassware]



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Indian Standard

SPECIFICATION FOR
CALORIMETER THERMOMETERS

PART 1 SOLID-STEM THERMOMETERS

1. Scope — Prescribes the requirements for a series of short-range solid-stem calorimeter thermometers, graduated for vertical, total and partial immersion, for use in bomb calorimetry and other purposes where an accurate measurement of a change of temperature is required.

2. Terminology — For the purpose of this standard, the definitions given in IS : 2627-1979 'Glossary of terms relating to liquid-in-glass thermometers (first revision)' shall apply.

3. Type — The thermometers shall be of the mercury-in-glass solid-stem type with enamel back and scale etched/permanently marked on stem (see Fig. 1).



FIG. 1 SOLID-STEM CALORIMETER THERMOMETER

4. Calibration and Immersion

4.1 The thermometers shall be calibrated in degrees celsius (°C).

4.2 The thermometers shall preferably be calibrated for use at total immersion (that is, the reading is taken when the thermometer is vertical and immersed at least to the end of the liquid column in the

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medium where temperature is required to be measured). The calibration for use at partial immersion is permitted, if agreed to between the purchaser and the manufacturer. On partial immersion thermometers, a line shall be etched at least half way round the stem of the thermometer at the level to which it is intended to be immersed.

5. Requirements

5.1 Materials

5.1.1 Glass — Thermometer bulb shall be made of suitable thermometric glass (see IS : 4610-1968 Specification for glass tubes for general purposes and reference thermometers). The glass or glasses comprising the thermometer shall be so selected and processed that the finished thermometer shows the following characteristics:

- a) Stress in the glass shall be reduced to a level sufficient to minimize the possibility of fracture due to thermal or mechanical shock;
- b) The correction of the thermometer reading at the lowest temperature of the nominal range shall not change by more than 0.02°C immediately after the thermometer has been heated for 15 min at a temperature 30°C higher than the lowest temperature and allowed to cool naturally in air;
- c) The legibility of the reading shall not be impaired by devitrification or clouding;
- d) The meniscus shall not be distorted by defects or impurities in the glass.

5.1.2 Thermometric liquid — The recommended liquid is pure and dry mercury free from entrapped gases.

5.1.3 Gas filling — Above the mercury, thermometers may be either vacuum or gas-filled; in the latter case, only a dry, inert gas shall be used. In the case of a gas-filled thermometer, the meniscus is at the top of the scale, shall not change by more than 0.01°C when the temperature of the gas above the mercury is changed by 30°C .

Note — It is generally possible for this requirement to be satisfied if the internal pressure does not exceed 0.5 bar^* , when the thermometer is registering its maximum temperature.

5.2 Construction

5.2.1 Shape — The thermometers shall be straight and their external cross-section approximately circular.

5.2.2 Top finish — The top of the thermometer shall have a rounded finish, unless otherwise specially required.

5.2.3 Capillary tube — The inside of the capillary tube shall be smooth. The cross-sectional area of the bore shall not show variations from the average greater than 5 percent and the bore shall be wide enough to ensure that, without tapping, jumping of the meniscus does not exceed one half of the graduation interval when the temperature is rising at a uniform rate not exceeding 0.05°C per minute. In the case of thermometers calibrated for use at partial immersion, the volume of mercury contained in the capillary tube between the immersion line and the lowest figured scale line shall not exceed the equivalent of 2°C .

5.2.4 Expansion chamber (safety chamber) — The capillary tube shall have an enlargement at the top of sufficient size to allow heating of the thermometer to 70°C . This expansion chamber shall be pear-shaped, with the hemisphere at the top. It shall be so shaped that the meniscus remains in the narrow portion at temperatures up to 40°C .

5.2.5 Contraction chamber — A contraction chamber shall be provided so that the mercury does not recede into the bulb at 0°C . It shall be elongated and as narrow as possible, and shall be separated from the bulb by not less than 3 mm of capillary tube.

5.2.6 Enlargement of the Bore — No enlargement of the bore shall be so located as to produce a variation in the cross-section of the capillary tube in the scale portion greater than that permitted in 5.2.3.

5.2.7 Dimensions — The dimensions of the thermometers shall be as given in Table 1.

*bar = 10^5Pa .

TABLE 1 DIMENSIONS OF SOLID-STEM CALORIMETER THERMOMETERS

| SI No. | Detail | Dimensions mm |
|--------|--|-------------------------------|
| (1) | (2) | (3) |
| i) | Total length, <i>Max</i> | 760 |
| ii) | Distance from bottom of bulb to top of contraction chamber, <i>Max</i> | 110 |
| iii) | Distance from bottom of bulb to lower nominal limits of scale | 280 to 300 |
| iv) | Length of main scale (nominal limits), <i>Min</i> | 300 |
| v) | Distance from upper nominal limit of scale to top of thermometer, <i>Min</i> | 70 |
| vi) | Diameter of stem | 7 to 11 |
| vii) | External diameter of bulb | not greater than that of stem |
| viii) | Length of bulb to shoulder, <i>Min</i> | 40 |

6. Graduation and Figuring

6.1 The scales and graduation interval of the thermometers shall be as given in Table 2.

TABLE 2 GRADUATION OF SOLID-STEM CALORIMETER THERMOMETERS

| SI No. | Schedule No. | Graduation Interval, °C | Nominal Scale Range, °C |
|--------|--------------|-------------------------|-------------------------|
| (1) | (2) | (3) | (4) |
| i) | 1 | 0.01 | 9 to 15 |
| ii) | 2 | 0.01 | 12 to 18 |
| iii) | 3 | 0.01 | 15 to 21 |
| iv) | 4 | 0.01 | 18 to 24 |
| v) | 5 | 0.01 | 21 to 27 |
| vi) | 6 | 0.01 | 24 to 30 |
| vii) | 7 | 0.01 | 27 to 33 |
| viii) | 8 | 0.01 | 30 to 36 |
| ix) | 9 | 0.01 | 33 to 39 |
| x) | 10 | 0.01 | 36 to 42 |
| xi) | 11 | 0.01 | 39 to 45 |

6.2 The scale lines shall be clearly etched and of uniform thickness, which in no case shall exceed 0.05 mm. The lines shall be at right angles to the axis of the thermometer.

6.3 When the thermometer is held in a vertical position and viewed from the front, the left-hand ends of all the scale lines shall lie on an imaginary vertical line. When the thermometer is viewed so that the right-hand ends of the shorter lines, denoting an interval of 0.01°C, align with the left-hand side of the bore, longer lines at each 0.05°C shall extend across the bore towards the right. The shorter lines shall be about 1 mm long.

6.4 The figures shall be placed in such a way that an extension of the line to which they refer would bisect them. They may be placed either to the left or to the right of the scale lines, as preferred.

6.5 The scale lines shall be so positioned that the enamel backing in the stem provides a background for the figures, the scale and the mercury column when the latter is seen just beyond the left or right hand ends of the short lines (see Fig. 2).

Note — Figure 2 illustrates two different types of graduation and figuring for the thermometers.

6.6 The scale of the thermometer shall be extended by ten divisions (that is, 0.1°C) beyond the nominal limits given in Table 2.

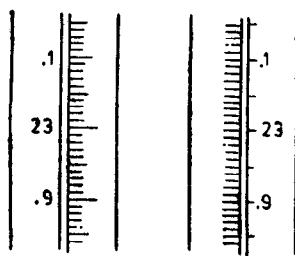


FIG. 2 ALTERNATIVE TYPES OF GRADUATION AND FIGURING

6.7 The scale shall be figured at each division of 0.1°C . Full figuring shall be provided at least at each division of 1°C and more frequently, if required.

6.8 All graduation lines and figures shall be clearly etched and filled with a pigment or permanently marked on the stem. The marking shall pass the test for permanency prescribed in Appendix A.

7. Accuracy

7.1 Scale Error — The scale error, when the thermometer is under normal atmospheric pressure and when the emergent liquid column (in the case of a partial immersion thermometer) is at the prescribed temperature, shall not be greater than 0.1°C .

7.2 Interval Error — The absolute value of the algebraic difference between the errors at any two points which are not more than 50 divisions apart shall in no case be greater than 0.01°C .

8. Marking and Packing

8.1 Marking — Each thermometer shall be marked permanently and legibly with the following:

- a) The letter ' $^{\circ}\text{C}$ ' near the top of the scale;
- b) Manufacturer's name or his recognized trade-mark, if any;
- c) Serial number of the thermometer;
- d) Schedule No;
- e) Schedule mark followed by letter 'TI' or 'PI' as the case may be;
- f) Gas filling, if any, for example N F for nitrogen filled; and
- g) *Immersion line* — On each thermometer graduated for use at partial immersion, the immersion depth shall be indicated and the emergent stem temperature for which the thermometer was calibrated shall be marked.

8.1.1 Certification marking — Details available with the Bureau of Indian Standards.

8.2 Packing — Each thermometer shall be suitably packed as agreed to between the purchaser and the manufacturer.

9. Testing and Inspection — Each thermometer shall be tested for conformity to all the requirements of this specification. The accuracy test shall be carried out in accordance with IS : 6274-1971 'Method of calibrating liquid-in-glass thermometers'.

APPENDIX A

(Clause 6.8)

TEST FOR PERMANENCY OF MARKING

A-1. Procedure

A-1.1 Place the thermometers in a 5 percent (m/v) solution of phenol in water maintained at $37 \pm 0.5^{\circ}\text{C}$ for a period of 20 minutes.

A-1.2 Wipe the thermometer dry with a piece of soft cloth and examine.

A-1.3 The thermometers shall be considered to have passed the test if, after this treatment, the marking does not peel off any where.

EXPLANATORY NOTE

This standard is based on ISO 651-1975 'Solid-stem calorimeter thermometers', issued by the International Organization for Standardization (ISO).

The calorimeter thermometers are not provided with auxiliary scales at 0°C and are, therefore, not suited to the absolute measurement of temperature, unless they are checked against a standard thermometer immediate before use. The enclosed scale thermometers are covered in Part 2 of this standard.